WHY MEN WERE KILLED AT PENNSYLVANIA ANTHRACITE MINES IN 1950

BY J. J. FORBES AND H. F. WEAVER

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INTRODUCTION

The investigation of major and minor coal-mine disasters has been a routine function of the Bureau of Mines since its inception in 1910, and the facts obtained during such investigations have been used as a basis for determining the precautions that the managements and employees of many mines are observing to forestall similar occurrences. The Bureau has conducted research on roof-control and other mine problems, but a comprehensive study of other fatal accidents was not attempted until February 10, 1950, when the policy of investigating all coal-mine fatalities in the United States was approved by Bureau of Mines Director James Boyd.

The investigations are being conducted by Federal coal-mine inspectors functioning under the provisions of the Coal Mine Inspection and Investigation Act of May, 1941, Public Law 49; and reports covering the investigations are distributed to management, the State mine-inspection agency, and representatives of the mine workers' organization have jurisdiction at the mine.

SCOPE AND PURPOSE OF STUDY

This study covers the Federal investigation of 76 of the 92 fatalities that were charged to the anthracite industry of Pennsylvania during the calendar year 1950.

The information in the fatality reports was condensed and arranged in such a manner that it would be useful to officials of coal companies and of the mine workers' organization in planning future accident-prevention programs; to safety instructors who must present material of personal interest so the causes of accidents will be well-known to class members and so the means to prevent them will not be forgotten quickly; to safety directors, inspectors, and supervisors who need such information to better carry out their duties; and to those interested in coal-mine safety for discussion at meetings. The ultimate objective is to provide information that will be helpful in preventing coal-mine accidents.

FATALITIES CHARGED TO FALLS OF ROOF, FACE, OR RIB

Detailed Information

1. Thirty-one (66 percent) of the 47 investigated fatalities charged to falls of roof, face, or rib occurred at the face, 9 (20 percent in chambers or breasts outby the face area, 3 (6 percent) on haulageways, 3 (6 percent) in abandoned or worked-out area, and 1 (2 percent) on a slope.

2. Eighteen (44 percent) of the 41 chamber, breast, and face fatalities occurred in places where loading was done by hand onto conveyors, 11 (27 percent)

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in places where coal moved by gravity to the main transporting medium, 9 (22 percent) in places where loading was done by hand into mine cars, and 3 (7 percent) in places where coal was moved from the face to mine cars by means of scrapers.

3. Thirty (64 percent) of the 47 roof-fall fatalities occurred in solid workings, and 17 (36 percent) occurred in pillar workings.

4. Falls of roof rock accounted for 31 (66 percent) of the 47 fatalities investigated, falls of rib caused 6 (13 percent), rush of material caused 6 (13 percent), and falls of roof coal resulted in 4 (8 percent).

5. The average dimensions of 26 of the pieces of roof rock that fell and resulted in fatalities were 9 feet in length, 8 feet in width, and 1 feet in thickness. The largest piece was 14 feet long, 21 feet wide, and 24 inches thick; the smallest was 18 inches long, 15 inches wide, and 6 inches thick.

6. Eighteen (58 percent) of the 31 face fatalities resulted from roof rock that fell between the last permanent roof support and the face. Four of the places where these 18 fatalities occurred had been reasonably well supported to the face before blasting, but some of the supports had been dislodged by blasting. However, in those places where the remaining 14 fatalities occurred no temporary supports had been stood between the last permanent support and the face and no supports had been dislodged by blasting.

7. The average distance between the last permanent roof support and the face (in those instances in which roof rock fell between the last permanent support and the face) was 14 feet.

8. Roof bolts were not in use at any of the places where roof-fall fatalities occurred.

9. Roof-fall fatalities, by size of mine based on employment, were:

Employment:	Fatalities
1-24 men	2
25-99 men	0
100-299 men	9
300-499 men	6
500 men and over	30

10. The average age of the 47 roof-fall victims was 42 years, and their average term of experience in mines was 19 years.

11. Fatalities from falls of roof, face, and rib, by occupation of the victim when injured are listed as follows:

a.	Miner	26
b.	Laborer	13
c.	Foreman	2
d.	Muck boss	1
e.	Company man	1
f.	Timberman	1
g.	Timberman helper	1
h.	Motorman	1
i.	Brakeman	1

Note: The motorman and brakemen were killed while waiting at the working face for the miner to finish loading a car.

12. The study disclosed that management failure was responsible for 6 (13 percent) of the 47 fatalities charged to falls of roof, face, or rib; employee failure, for 24 (51 percent); joint or undetermined failure, for 4 (8 percent); and dangers that could not be foreseen, for 13 (28 percent).

a. Fatalities charged to management were due to the following failures:

1. The foremen did not require hitching props at top and bottom to hold rib he inspected and knew was loose.. 1
2. The foreman inspected the working place 30 minutes before the accident occurred and allowed men to continue working under draw rock that practice required taking down as coal was removed............. 1
3. The foreman, who was the victim, did not have the roof examined or examine it himself............... 1
4. The foreman failed to detect obviously bad roof that fell 30 minutes after he had visited the place.. 1
5. The foreman allowed a miner to advance place in crushed ground, using props for support instead of timber sets, which the condition demanded....... 1
6. The foreman was assisting a miner to replace a timber set dislodged by blasting without requiring the miner to place temporary supports under a saddle known to be dangerous............... 1

b. Fatalities charged to employees were due to the following failures:

1. The miner did not detect bad roof that obviously could have been discovered by proper testing....... 4

2. Timber sets were not stood at the established interval..3

3. Visits to abandoned or worked-out area were unauthorized..3

4. Props dislodged by blasting were not reset promptly as space became available................3

5. Motorman and brakeman, who were the victims, were waiting at face of place until miner finished loading cars. The miner did not take care of known bad roof condition.......... 2

6. Victim did not take down known loose overhang before digging in coal beneath it.............. 1

7. Workman did not follow instructions to stand a relief timber before removing a set pushed out of line..1

8. Miner climbed lagging to get to working place instead of using available ladder. Lagging pulled out of place, and fall onto roadway resulted in his death............................ 1

9. Miner did not follow established practice of retreating to the gangway before blasting at face of breast.................................. 1

10. Victim started to clear space for resetting props dislodged by blasting without examining roof.. 1

11. Workman entered a chute to start the flow of coal and exposed himself unnecessarily to known danger.................................. 1

12. Workman failed to follow foreman's instructions to recover shaker pans and vacate place........ 1

13. A laborer, who was the victim, advanced to face after blasting before the miner had examined the place.................................... 1

14. Miner failed in attempt to pull down loose roof. He then advanced 6 feet under the loose piece to clear space for a prop and the roof fell.... 1

c. Fatalities were charged to joint or undetermined failure under the following conditions:

1. Miner was struck by roof he was barring down.. 1

2. The foreman detected loose roof in a place and instructed the miner to pull it down. When this attempt failed the foreman instructed the miner to shoot down the rock and left the place before assuring himself that his instruction was followed. The miner continued to load coal and was killed when the rock fell................................ 1

3. A miner and laborer had been instructed by the second shift foreman to square up the face of a chamber and stop the place. The place was given an official inspection 2-1/2 hours before the victims entered the chamber on the second shift. Only one row of props had been stood in the chamber, and they were 14 feet from the upper rib The rock fell in this unsupported area and killed the miner and laborer who were shoveling coal into a pan line........................ 2

d. Fatalities were charged to the category "danger could not be foreseen" under the following conditions:

1. The place was seemingly well supported, but rock fell between the supports............. 3

2. Large slab of coal fell from undetectable slip in rib.................................. 2

3. Unusual inrush of coal broke through forepoles at face of breast.................... 2

4. Victim's neck was caught between a post and a board he was using to move coal in a chute..................................... 1

5. The thick piece of sandstone that fell on a gangway could not be detected........... 1

6. The leg of a timber set was forced out of position and struck the victim, who was helping to stand a relief set............. 1

7. The victim was replacing lagging over timbers on a slope when an inrush of top coal covered him........................... 1

8. The place was well-timbered, but a large piece of rock 11 feet thick rolled off the rib and dislodged numerous props.............. 1

9. Bell that could not be detected fell and struck victim................................... 1

Conclusions

Sixty-four percent of the investigated fatal accidents that occurred at underground anthracite mines of Pennsylvania during the calendar year 1950 were charged to falls of roof, face, or rib. This record leaves no doubt as to the "No. 1 killer" of mine personnel and is a challenge to all the forces interested in forwarding safety in the anthracite industry, including management, labor, and State and Federal inspection agencies.

The study revealed that 66 percent of all the roof-fall fatalities investigated resulted from accidents that occurred in the face region. Fifty-eight percent of the face fatalities resulted from roof rock that fell between the last permanent support and the face; the average length of this area was 14 feet, and at the time the falls occurred temporary supports were not in position in the area.

The average dimensions of 26 of the pieces of roof rock that fell and resulted in fatalities were 9 feet in length, 8 feet in width, and 1 foot in thickness, showing the possibility of preventing many falls by the installation of a reasonable number of supports in the immediate face area.

Forty-four percent of the 41 chamber, breast, and face fatalities occurred in relatively flat places where loading was done by hand onto conveyors, whereas only 7 percent occurred in places where coal was moved by means of scraper conveyors. Twenty-seven percent occurred in steeply pitching places where coal moved by gravity to the loading point, and 22 percent occurred in places where loading was done by hand into cars.

It is difficult to understand why so many roof-fall fatalities occurred where coal was loaded by hand onto conveyors. According to Bureau of Mines records, 35 percent of the underground anthracite production comes from places where shaker, chain, and belt conveyors are used, but 58 percent of the face roof-fall fatalities occurred where coal was hand-loaded onto conveyors and close timbering presented no particular operating problem.

The average age of the 47 roof-fall victims was 42 years, and their average experience in mines was 19 years. These data do not support the theory that inexperienced persons generally are prone to such accidents. On the contrary, they support the contention that long and close association with dangers causes men to become inured to them.

The study indicated that human failure was responsible for 72 percent of all the investigated fatalities resulting from falls of roof, rib, or face and that unforeseen roof-fall accidents believed to be unavoidable accounted

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for the remaining 28 percent. Management failure was responsible for 13 percent; employee failure, 51 percent; joint or undetermined failure, 8 percent; and unforeseeable accidents, 28 percent.

Review of the 14 different employee failures to which the fatalities were attributed indicates the vital need for employees to be more alert to the dangerous conditions that develop in their respective working places. While it is likely that more frequent inspections by the foremen would have meant the correction of conditions that resulted in some of the roof-fall fatalities, the circumstances surrounding others indicate that nearly constant official supervision would have been necessary to forestall them.

Inasmuch as accidents resulting in 72 percent of all the roof-fall fatalities investigated could have been foreseen and prevented, it is clear that great strides toward the elimination of the "No. 1 killer" of mine personnel can be made, but only when all the forces that deal with mine safety make a more concerted and determined effort in that direction.

Recommendations

The following recommendations based on information obtained through this study are intended to reduce the incidence of roof-fall accidents in the anthracite mines of Pennsylvania:

To Management

1. Where practicable, minimum standards for systematic roof support suitable to the conditions encountered should be adopted and followed. The plan should show the minimum number and location of supports, either temporary or permanent, that should be installed in the area near the face where men must work or travel. The men should be instructed not to advance inby the last face support except those required to install the supports or to inspect the place.

2. The roof, ribs, and face of each working place and the roof and ribs of passageways where men work or travel should be examined by a certified official as often as necessary to insure greater safety for the workmen. Where dangerous conditions are found the foreman should see that they are corrected promptly.

3. The bolting method of roof support should be adopted in areas where bolting is determined through experiments to be feasible and practicable. Controlled experiments to determine whether roof bolting is applicable should be made in conformance with the procedures that have been worked out by the Bureau of Mines. Bureau experiments are made under controlled conditions, using auxiliary conventional supports during the initial experimentation. After a safe and economical method of bolting is determined, no deviation from the method should be condoned without further experimental work. Also, if the roof conditions change radically over those encountered during the initial experimental period, new experiments should be made.

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To Employees

1. Employees should cooperate fully with management in developing a suitable roof-support plan and in obtaining compliance with it.

2. In the absence of the foreman the employees should be constantly alert for changes in conditions and should take immediate steps to eliminate any danger that might arise. When the miner is not sure of the action that should be taken the place should be vacated and the foreman notified.

3. Motormen, brakemen, and others whose duties do not require them to be at the working face should stay out of face areas.

4. Roof supports dislodged by blasting should be replaced promptly as space is made available. Special care should be taken to properly place the drill holes and to avoid overcharging them so the roof supports will not be dislodged by blasting.

5. Face workers and other employees exposed to hazards from roof falls should examine their places and test the roof, face, and ribs thoroughly before beginning work after blasting and at frequent intervals during the shift. Dangerous conditions should be corrected before other work is done.

6. Employees should not enter abandoned areas or worked-out places without authorization.

FATALITIES AT UNDERGROUND MINES CHARGED TO HAULAGE

Detailed Information

1. Eleven (15 percent) of the investigated fatalities that occurred at underground mines were charged to haulage.

2. Five (45 percent) of the haulage fatalities occurred on the surface at underground mines, 3 (27 percent) on haulageways, 2 (18 percent) in a shaft, and 1 (10 percent) on a slope.

3. Haulage fatalities, by occupation at the time of injury, are listed below:

a.	Motorman	3
b.	Railroad car runner	2
c.	Shaft repairman	2
d.	Brakeman	1
e.	Truck driver	1
f.	Timber cutter helper	1
g.	Laborer	1

4. Haulage fatalities, by size of mine based on employment, were:

Employment:	Fatalities
1- 24 men	1
25- 99 men	0
100-299 men	2
300-499 men	3
500 men and over	5

5. The average age of the haulage victims was 43 years, their average experience in and around mines was 24 years, and their average experience in the occupation at time of injury was 11 years.

6. Employee failure was responsible for 5 (46 percent) of the haulage fatalities at underground mines; joint or undetermined failure, for 2 (18 percent); unforeseen accidents, for 2 (18 percent); and unknown causes, for the remaining 2 (18 percent).

a. Fatalities charged to employees were due to the following failures:

1. Motorman was aware that a coupling on the car of a rope trip was defective. He did not report it to the foreman or use an auxiliary coupling with a hook at both ends. Coupling broke as trip was being hoisted, and the runaway car struct the motorman...... 1

2. The victim, a laborer on the surface, walked backwards in front of a moving car to release a tugger-rope hook. Victim stumbled and fell under car.. 1

3. A railroad car runner attempted to board a moving railroad car and fell under it........ 1

4. A railroad car runner did not wear the safety belt provided and fell under a moving car.... 1

5. The victim failed to change the direction lever of a storage-battery locomotive used on the surface from the reverse to forward position. When he applied the power (4 notches) the locomotive broke through a substantially constructed headblock, tipped over, and the batteries broke loose from their moorings and killed the operator....... 1

b. Fatalities were charged to joint or undetermined failure under the following conditions:

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1. Operator of a "light" locomotive was following a loaded trip at an interval of around 25 feet. It was presumed that a chunk of topping from one of the loaded cars dislodged a collar that struck the motorman of the "light" locomovtive... 1

2. A truck being used to transport coal from mine to breaker collided with another truck on a highway. The driver of the coal truck was killed.. 1

c. The following fatalities were charged to "cause unknown":

1. A motorman was found underneath the locomotive he was assigned to operate. There were no witnesses of the accident........................ 1

2. A brakeman sitting in his usual position atop a moving locomotive fell off or raised up, struck a collar, and was knocked off the locomotive. The minimum vertical clearance at the place where the accident occurred was 36 inches.............. 1

d. Fatalities were charged to the category "danger not foreseen" under the following conditions:

1. Shaft repairmen were on a substantial platform installed in a hoisting compartment of a shaft, and the working platform was protected by a substantial covering platform. Rock from the adjacent air shaft fell, broke through the separation wall, canopy, and platform, causing the victims to fall to the shaft bottom...................................... 2

Conclusions

Fifteen percent of the investigated fatalities at underground mines were charged to haulage. Even though far fewer haulage personnel are employed on the surface at underground operations than in the mines, accidents resulting in 45 percent of the haulage fatalities occurred on the surface at underground operations.

Human failure was responsible for 64 percent of the haulage fatalities. Employee failure accounted for 46 percent; joint or undetermined failure, 18 percent; unforeseeable accidents, 18 percent; and unknown causes, the remaining 18 percent.

Recommendations

The conditions and circumstances surrounding the haulage accidents resulting from employee failure indicate, generally, the precautions that should be taken to avoid recurrences. However, the recommended precautions will be "spelled out" so that they can be easily understood.

1. Haulage employees should sidetrack cars with known defective couplings and report the condition to the foreman.

2. Employees should not walk in front of a moving car to release a tugger-rope hook.

3. Car runners should not attempt to board moving railroad cars.

4. Car runners should use safety belts when dropping railroad cars.

5. Operators of locomotives should assure themselves that the direction lever is in the correct position before moving the controller lever.

FATALITIES AT UNDERGROUND OPERATIONS DUE TO OTHER CAUSES

Circumstances surrounding the accidents at underground operations charged to categories other than falls of roof and haulage were so variable that it was deemed advisable to cover them separately:

1. A truck driver was guiding a piece of steel pipe being moved into loading position by means of a crane when the crane boom contacted a high-potential cable and electrocuted the truck driver. In this instance, the power cable was suspended 30 feet above the ground level, and the crane should not have been operated near it while power was on the line.

2. A foreman was supervising the rerailing of a car underground, and the locomotive being used to pull the derailed car became "charged" owing to heavily sanded rails. The victim, a brakeman presumably unaware of this condition, touched the locomotive and was electrocuted.

3. The foreman had inspected a place where men were preparing to blast. He then proceeded to the adjoining idle place to take some measurements and, according to the report, did not advise the workmen that we would return to their place after the measurements were completed. The miner, assuming that the foreman was in the clear, fired the shots that resulted in the foreman's death.

4. Two miners were preparing to blast at the face of a tunnel. Lightning struck the surface firing station and set off the charges, killing both men.

5. A gas explosion in a rock tunnel resulted in the death of a miner and three laborers. According to the investigation report, the last official examination of the tunnel for gas and other hazards was made at 5:30 a.m. the day before the explosion. The gas was ignited by a trolley locomotive operated by one of the victims.

6. The explosion of an accumulation of methane gas in an underground transformer room resulted in the death of an electrician. The transformer room was not properly ventilated, an ignition source existed therein, and proper precautions were not taken to prevent the gas from entering the transformer room.

7. Coal that "hung" in a chute collapsed suddenly, depositing the victim with the coal into a void below made by loading coal therefrom. The victim, a miner who was atop the loose coal in the breast did not know that coal was being loaded from the chute, and he had not constructed a safety platform on which to stand while working.

8. An outburst of methane and accompanying rush of coal at a point where a rock hole tapped a vertical vein resulted in the miner being engulfed and suffocated. It is doubtful that this danger could have been foreseen.

9. The victim, a driver-loader, was found in a car filled with coal that was "spotted" at the loading chute of a breast. Presumably the victim slipped and fell into the car after he had started the flow of coal.

10. The base of a ladder being used by a carpenter was set too close to a building against which the top of the ladder was leaning. When he attempted to get on the ladder at a point where the top touched the building it toppled over, and the victim fell to the ground.

11. An electrician was using an improvised and totally ineffective safety belt, made of a single loop of rope that encircled the pole and his body, while performing the duties of a lineman from his position on a pole. One of his "climbers" slipped, and the victim fell to the ground.

12. A laborer was assisting in the dismantling of a breaker. He was standing on an elevator drive platform within the building bumping boards from the roof rafters with a piece of scantling when he fell 36 feet to the main floor. As there were no witnesses, the cause of the fall was unknown.

FATALITIES AT STRIP MINES

Two strip-mine accidents, resulting in the death of two men, were investigated by Federal coal-mine inspectors. One involved a foreman who, presumably, while investigating a cavity in loose material that had been blasted, was covered by a slide. The other involved a truck driver who, while standing on the running board of a truck as it was being loaded, was crushed to death when another truck was inadvertently backed into the truck on which he was standing.

GENERAL CONCLUSIONS

This is the first time in the history of coal mining that the United States Bureau of Mines has assembled, on such a broad basis, detailed reports on the investigation of coal-mine fatalities.

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As a result of this study of fatalities in and around anthracite mines in 1950, it has been determined that management failure was responsible for 13 (17 percent) of the 76 fatalities investigated; employee failure, 32 (42 percent); joint or undetermined failure, 9 (12 percent); unforeseen causes, 18 (24 percent); and unknown causes, the remaining 4 (5 percent). Therefore, approximately 71 percent of the fatalities that occurred in the anthracite mines of Pennsylvania in 1950 were the result of human failure and could have been prevented. Obviously, a more determined attempt must be made to prevent accidents due to human failure, and the job can be done through the sincere cooperation and intensified interest of all concerned with mine safety. One way to accomplish this purpose is through proper education, in safety fundamentals, of each supervisor and each mine employee. Management should assume the responsibility of training its supervisors; and when considered advisable, the safety educational facilities of the United States Bureau of Mines or other agencies should be utilized to supplement management's program. Employees also should take special training courses in accident prevention; such training is offered by the United States Bureau of Mines, by the management of some companies, and by other agencies.

Anything that can be done to awaken individual responsibility in the mine safety problem is a definite advance toward the successful elimination of mine accidents.